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EXAMINER	
ROMANO, JOHN J	

ART UNIT	PAPER NUMBER
2192	

DATE MAILED: 06/15/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/087,296	SETH ET AL.	
	Examiner	Art Unit	
	John J. Romano	2192	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *19 April 2006*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-44* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-44* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 11/14/2005 has been entered.

Applicant's amendment and response received April 19th, 2006, responding to the April 06th, 2006, Office action provided in the rejections of claims 1-44, wherein claims 1, 7, 12, 14, 18, 24, 28, 32, 34, 35, 39 and 43 have been amended. Claims 1-44, remain pending in the application and which have been fully considered by the examiner.

Prior Art's Arguments – Rejections

1. Applicant's arguments filed April 19th, 2006, in particular on pages 13 and 14, have been fully considered but they are not persuasive. For example,

(A) In response to applicant's argument that **Bartley** does not relate to code performance, (page 14 of the amendment and response, first paragraph), the examiner respectfully disagrees. It should be noted that Applicant defines user specified real-time constraints as follows (See specification, page 12, lines 10-13), "The user-specified real-time constraints can include constraints such as the number of power down

instructions that can be inserted in an execution path, the number of additional cycles of execution time the user is willing to incur, and other such constraints". That is to say that the aforementioned code *performance* constraints as amended, reduce power by constraining execution instructions, execution time and other such constraints.

Bartley discloses "In the case of either a compiler or assembler, an optimizing process finds, for each functional unit, program segments during which the functional unit is not used are located. These segments would be of *longer duration* than some *predetermined threshold*. Once these segments are found, the compiler then inserts a power-modifying instruction at the point I the code when the functional unit first goes out of use." (Column 7, lines 42-43), wherein the threshold is a specified time duration. This section of Bartley, clearly teaches modifying code depending on time constraints to reduce power consumption. Therefore, **Bartley's** teaching of a time threshold would have been sufficient motivation to one of ordinary skill in the art, at the time the invention was made to consider execution time in relation to instructions to save power. Thus, the rejection is maintained in light of the instant argument

Li discloses section 3.3, "Software Energy and Performance Model", wherein the execution time of the program and the number of instructions in the program are disclosed to directly affect the software performance model. Li further teaches "Goal II: minimized power under performance constraints" (See Li, page 4, Section 4.3 "System-Level Energy Optimization Algorithm". Thus, it would have been obvious to from Li and Bartley's teachings to satisfy user specified real-time performance constraints while inserting power down instructions to reduce the power consumption as claimed in the

independent claims. Therefore, the examiner maintains the position that **Bartley** and **Li** are reasonably pertinent to the particular problem with which the applicant was concerned, namely energy conservation and the rejection is maintained in light of the amendments.

(B) Independent claims 14, 24 and 34 are rejected for the reasons stated above, as Applicant relies on the same argument as noted above. Thus, Claims 2-10, 15-21, 25-31 and 35-42 are also rejected for at least the reason that they are dependent on a rejected base claim.

Claim Rejections

2. Claims 1-44, are pending claims, and stand finally rejected in light of the additional clarifications provided and/or addressed at item 2 above, Prior Art's Arguments – Rejections and as provided below for completeness.

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

4. Claims **1, 2, 11-15, 22-25, 32-36, 43** and **44** are rejected under 35 U.S.C. 103(a) as being unpatentable over Bartley, US 6,219,796 (hereinafter **Bartley**), in view of Y. Li

et al. A framework for estimating and minimizing energy dissipation of embedded hw/sw systems, (hereinafter **Li**).

5. In regard to claim **1**, **Bartley** discloses:

- "*A method of compiling computer code including power-down instructions to reduce power consumption during execution of the code...*" (E.g., see Figure 7 & Column 2, lines 62-67), wherein it is inherent that the code is efficient when executed by a processor.
- "*...identifying one or more potential locations in the computer code where the power-down instructions can be inserted...*" (E.g., see Figure 7 & Column 7, lines 10-21), wherein the potential locations are identified by scanning the code.
- "*...selecting locations to insert the power-down instructions from the identified potential locations in the code based on reducing power consumption ...*" (E.g., see Figure 7 & Column 7, lines 39-43), wherein the locations are determined by a predetermined threshold duration of non-use.
- "*...inserting the power-down instructions in the selected locations to reduce the power consumption during the execution of the code ...*" (E.g., see Figure 7 & Column 7, lines 43-46), wherein the power modifying or power-down instruction is then inserted to reduce the power consumption.

But **Bartley** does not expressly disclose "...*satisfying user-specified real-time constraints...*". However, **Li** discloses:

- "...*satisfying user-specified real-time performance constraints...*" (E.g., see Figure 5 & Page 4, Section 4.3), wherein the user specifies one of many multiple objective optimization goals via performance constraints.

Bartley and **Li** are analogous art because they are both concerned with the same field of endeavor, namely, an optimizing compiler with the means to reduce power or energy consumption. Therefore, at the time the invention was made, it would have been obvious to a person of ordinary skill in the art to combine user specified real-time constraints with **Bartleys'** power reduction methods. The motivation is disclosed by **Bartley,** as he refers to program segments having a duration longer than a "predetermined threshold." (Column 7, lines 42-43), wherein it is obvious the threshold may be determined by a user either via a user selected algorithm or other user input.

6. In regard to claim **2**, the rejections of base claim **1** are incorporated. Furthermore, **Bartley** discloses:

- "...*wherein the code is written for a microprocessor having distinct functional units.*" (E.g. see Figure 7 & Column 3, lines 3-8) wherein the common characteristic is any processor or microprocessor that has more than one independent or distinct functional units.

7. In regard to claim **11**, the rejections of base claim **1** are incorporated. Furthermore, **Li** discloses:

- "... *the number of power-down instructions that can be inserted in an execution path, including one or more identified potential locations.*" (E.g. see Table 2 & Section 5.2), wherein the time improvement or a negative time improvement as a performance constraint is taught and may be used to limit the number of instructions inserted.

Therefore, at the time the invention was made, it would have been obvious to a person of ordinary skill in the art to combine **Li's** user specified real-time constraints with **Bartleys'** power reduction methods. The motivation is disclosed by **Bartley,** as he refers to program segments having a duration longer than a "predetermined threshold." (Column 7, lines 42-43), wherein it is obvious the threshold may be determined by a user either via a user selected algorithm or other user input. Furthermore, the segment is a direct relationship to **Li's** teaching of user specified performance constraint of time or execution cycles executed as a consequence of the energy savings. Additionally, **Bartley** provided the motivation for a number of power down instructions (E.g. see, Figure 5 & Column 2, line 11) wherein, it would have been obvious to one of ordinary skill in the art, to factor in particular power down instructions and the number of such instructions, based on the energy savings in relation to the overhead drawback.

8. In regard to claim **12**, the rejections of base claim **11** are incorporated. Furthermore, **Li** discloses.

- "...*the number of additional cycles of execution time the user is willing to incur due to an insertion of the power-down instruction at each of the identified potential locations.*" (E.g. see Table 2 & Section 5.2), wherein

the "...minimum energy dissipation while not exceeding the budget of clock cycles to execute..." is taught.

Therefore, at the time the invention was made, it would have been obvious to a person of ordinary skill in the art to combine user specified real-time constraints with **Bartleys'** power reduction methods. The motivation is disclosed by **Bartley,** as he refers to program segments having a duration longer than a "predetermined threshold." (Column 7, lines 42-43), wherein it is obvious the threshold may be determined by a user either via a user selected algorithm or other user input.

9. In regard to claim **13**, the rejections of base claim **11** and claim **12** are incorporated. Furthermore **Bartley** discloses:

- "...*inserting power-up instruction in the code to restore at least one functional unit to a ready state powered-down by the inserted power-down instructions..*" (E.g. see Figure 7 & Column 6, lines 8-19), wherein the power up instruction is inserted.

Therefore, at the time the invention was made, it would have been obvious to a person of ordinary skill in the art to combine **Li's** user specified real-time constraints with **Bartleys'** power reduction methods. The motivation is disclosed by **Bartley,** as he refers to program segments having a duration longer than a "predetermined threshold." (Column 7, lines 42-43), wherein it is obvious the threshold may be determined by a user either via a user selected algorithm or other user input. Additionally, the segment is a direct relationship to **Li's** teaching of user specified performance constraint of time or execution cycles executed as a consequence of the energy savings.

10. As per claims **14, 15, 22** and **23,** this is a computer-readable medium version of the claimed method discussed above, in claims **1, 2, 11** and **13,** wherein all claimed limitations have also been addressed and/or cited as set forth above, wherein **Bartley** also discloses "a storage device and external memory" (16), (E.g. see, Figure 1 and associated text).

11. As per claims **24, 25, 32** and **33,** this is a computer system version of the claimed method discussed above, in claims **1, 2, 11** and **13,** wherein all claimed limitations have also been addressed and/or cited as set forth above, wherein **Bartley** also discloses a computer system (E.g. see, Figure 1 and associated text).

12. In regard to claim **34**, the rejections of claim **1** are incorporated. Additionally, **Bartley** discloses:

- "*A computer readable medium having a computer program including instructions for causing a computer to perform a method of selectively controlling power to different functional units of the computer, the instructions comprising...*" (E.g., see Figure 7 & Column 7, lines 10-21), wherein it is inherent that the instructions have to be on a computer-readable medium to be scanned by a computer process.
- "*...power-down instructions inserted in the computer-program in selected locations based on reducing power consumption...*" (E.g., see Figure 7 & Column 7, lines 10-21), wherein the potential locations are identified by scanning the code.

- "...*the power-down instructions in the selected locations reduce the power consumption during the execution of the code...*" (E.g., see Figure 7 & Column 2, lines 6-13), wherein the locations are determined by a predetermined threshold duration of non-use.

13. As per claims **35, 36, 43** and **44,** the base claim **34** is incorporated. Furthermore, this is another computer-readable medium version of the claimed method discussed above, in claims **1, 2, 11** and **13,** wherein all claimed limitations have also been addressed and/or cited as set forth above, (E.g. see Figure 1 & associated text), wherein a computer readable medium is shown (16).

14. Claims **3-10, 16-21, 26-31** and **37-42** are rejected under 35 U.S.C. 103(a) as being unpatentable over **Bartley** in view of **Li** and further in view of G. Ramalingam. Data Flow Frequency Analysis, SIGPLAN Conference on Programming Language Design and Implementation, 1996, (hereinafter **Ramalingam**).

15. In regard to claim **3**, the rejections of base claim **2** are incorporated. Furthermore, **Bartley** discloses:

- "... *based on the functional units not being used in the potential locations, wherein the functional units not being used are determined based on functional unit usage* ..." (E.g. see Figure 7 & Column 7, lines 10-21), wherein the functional units are not used.

But **Bartley** does not specifically disclose a "*...transfer functions at each of the potential locations as specified in standard monotone data-flow frameworks.*" However, **Ramalingam** discloses:

- "*...transfer functions at each of the potential locations as specified in standard monotone data-flow frameworks.*" (E.g. see Section 3, The expected Frequency of Dataflow Facts), wherein the use of transfer functions as specified in standard monotone data-flow frameworks is taught.

The combined teaching and **Ramalingam** are analogous art because they are both concerned with the same field of endeavor, namely program optimization via standard analysis. Therefore, at the time the invention was made, it would have been obvious to a person of ordinary skill in the art to combine a transfer function with static analysis method disclosed by the combined art of an optimizing compiler embodiment. The motivation is disclosed by **Bartley,** "Locating program segments during which a functional unit is not used may be done by either static or dynamic program analysis." (Column 7, lines 47-49).

16. In regard to claim **4**, the rejections of base claim **3** are incorporated. Furthermore, **Bartley** discloses:

- "... *statically analyzing processor cycles prior to executing the code.*" (E.g. see Figure 7 & Column 7, lines 47-52), wherein the processor or execute cycles are estimated by the compiler for static analysis.

17. In regard to claim **5**, the rejections of base claim **4** are incorporated. Furthermore, **Bartley** discloses:

- "...*the text in the code...*" (E.g. see Figure 7 & Column 7, lines 47-52), wherein the start and stop points exist in the program segments or text in the code.

18. In regard to claim **6**, the rejections of base claim **3** are incorporated. Furthermore, **Bartley** discloses:

- "...*a first power-down instruction operable to reduce power to all of the at least one functional unit, such that the functional unit is placed in a low state of readiness and a second power-down instruction operable to reduce power to only a part of the at least one functional unit, such that the functional unit is placed in an intermediate state of readiness.*" (E.g. see Figure 6 & Column 6, line 60 – Column 7, line 3), wherein the "less ready" or low state and a "more ready" or intermediated state of readiness are taught.

19. In regard to claim **7**, the rejections of base claim **1** are incorporated. But Bartley does not expressly disclose "...*executing the code to generate power-profiling and execution path-profiling information...*" or "...*assigning a weight factor based on the profile information...*". However, **Li** discloses:

- "...*executing the code to generate power-profiling information associated with each of the identified potential locations...*" (E.g. see Figure 2 & Page 3, Section 3.4), wherein Figure 2 shows the program

execution trace which generates the software performance model and the software energy model is also generated based on the execution trace and then coupled with the memory energy models to account for the total system energy generating power information or a power-profile.

- "...*assigning a weight factor to each of the identified potential locations based on the generated power-profiling...*" (E.g. see Figure 5 & Section 4.2), wherein the EES/CSI ratio or weight factor prioritizes and then gets assigned a probability based on the ratio. Further the EES/CSI numbers are based on the profile information. Additionally, the user specifies constraints to be met in real-time in section 4.3.

But the combined teaching of **Bartley** and **Li** do not expressly disclose "...executing the code to generate path-profiling information...". However, **Ramalingam** discloses:

- "...*path-profiling information...*" (E.g. see Section 1), wherein the path-profiling information is used to estimate probability.
- "...*and path-profiling information; and selecting the locations to insert the power-down instruction from the identified locations based on the assigned weight factors...*" (E.g. see Section 3, lemma 2), wherein the result is "...weighted...".

Therefore, at the time the invention was made, it would have been obvious to a person of ordinary skill in the art to combine power and path profile information with

Bartleys' power reduction methods. Motivation was provided by **Bartley,** when he referred to static and dynamic analysis utilizing execution cycles, loop cycles and other "statistical predictions." (Column 7, lines 47-52), wherein it would have been obvious, at the time the invention was made, that **Li's** constraints and profile algorithm would be beneficial to the efficiency of a power reduction embodiment disclosed by **Bartley**. Furthermore, motivation was provided by **Li** (Figure 2) wherein, the program execution trace used by **Li** would only been beneficial if there was a probability that the path will actually be used.

20. In regard to claim **8**, the rejections of base claim **7** are incorporated. Furthermore, **Li** discloses:

- "...*generating execution probability of each of the identified potential locations based on the generated path-profiling information.*" (E.g. see Section 3, lemma 2), wherein the result is "...weighted..." by the probability of execution of the path.

Therefore, at the time the invention was made, it would have been obvious to a person of ordinary skill in the art to combine probability derived from path profile information with **Bartleys'** power reduction methods in order to increase the efficiency by increasing the depth of the analysis.

21. In regard to claim **9**, the rejections of base claim **8** are incorporated. Furthermore, **Li** discloses:

- "...*extracting potential energy savings for each of the identified potential locations using the generated power profile analysis*

information..." (E.g. see Figure 5 & Page 4, Section 4.2), wherein the EES is the estimated energy savings.

- "*...assigning the weight factor to each of the identified potential locations based on the extracted potential energy savings and the generated execution probability.*" (E.g. see Figure 5 & Page 4, Section 4.2), wherein the EES/CSI ratio or weight factor prioritizes and then gets assigned a probability based on the ratio. Further the EES/CSI numbers are based on the program execution trace or generated path-profiling information.

Therefore, at the time the invention was made, it would have been obvious to a person of ordinary skill in the art to combine potential energy savings derived from power profile information with **Bartleys'** power reduction methods in order to increase the efficiency by increasing the depth of the analysis.

22. In regard to claim **10**, the rejections of base claim **9** are incorporated. Furthermore, **Li** discloses:

- "*...executing the code to assign a first weight factor based on the extracted potential energy savings to each of the identified potential locations...*" (E.g. see Figure 2 & Column 3, lines 3-8), wherein the software performance model includes the product of execution cycles of a given instruction and the number of times an instruction is used or path profile and power information is factored to derive a weight factor.

- "... *executing the code to assign a second weight factor based on execution probability at each of the identified potential locations...*" (E.g. see Figure 2 & Column 3, lines 3-8), wherein the software performance model includes the product of execution cycles of a given instruction and the number of times an instruction is used or path profile.
- "...*computing a product of the first and second weight factors for each of the identified potential locations; calculating the weight factor for each of the identified potential locations based on the computed product of the first and second weight factors; and assigning the calculated weight factor to each of the identified potential locations.*" (E.g. see Figure 2 & Column 3, lines 3-8), wherein the software performance model includes the product of execution cycles of a given instruction and the number of times an instruction is used or path profile and the weight factor is assigned based on a product of weighted factors of both the energy savings or power profile and execution probability. The EES/CSI ratio as disclosed above is based on the products of path and profile information.

23. As per claims **16-21,** this is a computer-readable medium version of the claimed method discussed above, in claims **3, 4** and **7-10,** wherein all claimed limitations have also been addressed and/or cited as set forth above, (E.g. see Figure 1 & associated text), wherein a computer readable medium is shown (16).

24. As per claims **26-31,** this is a computer system version of the claimed method discussed above, in claims **3, 4** and **7-10,** wherein all claimed limitations have also been addressed and/or cited as set forth above, (E.g. see Figure 1 & Column 3, lines 3-8), wherein a computer system is shown.

25. As per claims **37-42,** the base claim **34** and **35** are incorporated. Furthermore, this is another computer system version of the claimed method discussed above, in claims **3, 4** and **7-10,** wherein all claimed limitations have also been addressed and/or cited as set forth above, (E.g. see Figure 2 & Column 3, lines 3-8), wherein a computer system is shown.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to John J. Romano whose telephone number is (571) 272-3872. The examiner can normally be reached on 8-5:30, M-F.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Tuan Q. Dam can be reached on (571) 272-3695. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

JJR

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SUPERVISORY PATENT EXAMINER